Operating instructions
for hydraulic systems

Rexroth
Bosch Group

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Replaces:

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1 Product specific information 6

1.1 Fundamental information 6

1.2 Intended purpose, scope of supply 6

1.3 Information regarding monitoring and safety functions 7

1.3.1 Monitoring functions 7
1.3.1.1 Monitoring the change of pressure fluid level 7
1.3.1.2 Monitoring via a level indicator 7
1.3.1.3 Monitoring via level indicator and temperature switch (if fitted) 7
1.3.2 Controlling and monitoring the pressure fluid temperature (if fitted) 7
1.3.3 Monitoring the filter 8
1.3.4 Protecting against unpermissible operating pressures 8
1.3.5 Information regarding safety measures 8
1.3.5.1 Category „B“ 8
1.3.5.2 Category „1“ 9
1.3.5.3 Category „2“ 9
1.3.5.4 Category „3“ 9
1.3.5.5 Category „4“ 9

1.4 Operating and environmental conditions 9

1.4.1 Climate 9
1.4.2 Ambient temperature 9
1.4.3 Protection 10
1.4.4 Pressure fluid 10
1.4.5 Hazard potential 10
1.4.5.1 Water contaminating products 10
1.4.5.2 Explosive surroundings 11

1.5 Unpermissible use 11

1.6 Hydraulic system residual risks 11

1.7 Herstellererklärung nach RDEF 00025/10.01 13

2 General information 14

2.1 Area of validity 14

2.2 Liability 14

2.3 Personnel qualification 14

2.3.1 Personnel for maintenance and inspection (chapter 5.1) 14
2.3.2 Personnel for commissioning (chapter 4), maintenance (chapter 5.2) and de-commissioning (chapter 6) 14

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2.4 Basic safety guidelines ... 15

2.5 Responsibilities and obligations of the machine manufacturer/operator ... 15

2.6 Conventions ... 16

2.7 Copyright ... 16

3 Transport and storage ... 17

3.1 Transport ... 17

3.1.1 Transport with a forklift truck ... 17

3.1.2 Transport with lifting equipment ... 17

3.2 Storage ... 18

3.2.1 Factory corrosion protection ... 18

3.2.2 Carrying out the internal corrosion protection ... 18

3.2.3 Notes on external protection ... 18

3.2.4 Guidelines for packing hydraulic components and units ... 19

4 Commissioning ... 19

4.1 General notes ... 19

4.1.1 Safety ... 19

4.1.2 Personnel qualifications ... 19

4.1.3 Cleanliness ... 19

4.1.4 Painting ... 19

4.2 Commissioning of functionally tested hydraulic units ... 19

4.2.1 Building in or on ... 19

4.2.1.1 Visual check for transport damage and contamination ... 19

4.2.1.2 Installation and fixing of units and sub-assemblies ... 19

4.2.1.3 Connecting the hydraulic drive ... 20

4.2.2 Filling the system ... 20

4.2.3 Before commissioning ... 20

4.2.4 Commissioning ... 21

4.3 Pressure fluid ... 22

4.3.1 Requirements and tasks ... 22

4.3.1.1 Pressure fluid requirements ... 22

4.3.1.2 Safety guidelines ... 22

4.3.1.3 The tasks of the pressure fluid ... 22

4.3.1.4 Hydraulic oil characteristics ... 22

4.3.1.5 Selection and maintenance of pressure fluids ... 22

4.3.2 Selecting the viscosity class ... 23

4.3.3 Oil type selection ... 24

4.3.3.1 HLP (DIN 51524 part 2) ... 24

4.3.3.2 HV (multi grade hydraulic oil) ... 24

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5 Maintenance 24

5.1 Maintenance and inspection 24

5.1.1 General notes 24
5.1.1.1 Personnel qualifications 24
5.1.1.2 Safety 24
5.1.1.3 Scope and time intervals for maintenance and inspection 24
5.1.1.4 Inspection documentation 24

5.1.2 Pressure fluid 25
5.1.2.1 Pressure fluid temperature 25
5.1.2.2 Pressure fluid condition 25
5.1.2.3 Changing the pressure fluid 25

5.1.3 Filter monitoring 25
5.1.3.1 Filters with a clogging indicator 25
5.1.3.2 Changing the filter element (see Maintenance 5.2.4) 26

5.1.4 Accumulators 26

5.1.5 Hoses 26
5.1.5.1 Hazards 26
5.1.5.2 Storage and service life 26
5.1.5.3 Testing 26
5.1.5.4 Storage time and service life 27
5.1.5.5 Inspection criteria (excerpt from DIN 20066) 27
5.1.5.6 Replacing hoses 27

5.1.6 Coolers 27

5.1.7 Set values 27

5.1.8 Maintenance and inspection intervals 28

5.2 Repairs 29

5.2.1 General guidelines 29
5.2.1.1 Personnel qualifications 29
5.2.1.2 Safety 29
5.2.1.3 Cleanliness 29

5.2.2 Maintenance tasks 29
5.2.2.1 Fault finding 29
5.2.2.2 Fault rectification 29
5.2.2.3 Functional testing and acceptance 29

5.2.3 Removing/fitting components 30

5.2.4 Changing the filter element 30
5.2.4.1 Changing the element 30
5.2.4.2 Exchanging or cleaning the filter elements 30

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5.2.5 Fault causes and their effect on hydraulic systems 30
5.2.5.1 Fault effect „A“: Excessive noises 31
5.2.5.2 Fault effect „B“: Insufficient power/torque (pressure) at the drives 32
5.2.5.3 Fault effect „C“: Uneven drive movements 32
5.2.5.4 Fault effect „D“: The drive does not move or is too slow (none or insufficient flow) 32
5.2.5.5 Fault effect „E“: The drive does not stop or follows on 33
5.2.5.6 Fault effect „F“: Pump on or off load switching too frequent 33
5.2.5.7 Fault effect „G“: Switching shocks when valves are switched 33
5.2.5.8 Fault effect „H“: Pressure fluid temperature too high 34
5.2.5.9 Fault effect „I“: Contaminated pressure fluid 34
5.2.6 Assembly guidelines for couplings to AB-E 33-22/KD 34
5.2.6.1 General 34
5.2.6.2 Assembling the coupling 35
5.2.6.3 Securing the coupling half onto the shaft 35
5.2.7 Assembly guidelines for vertically mounted motor pump assemblies 36
5.2.7.1 General safety guidelines 36
5.2.7.2 Disassembly procedures 36

6 Decommissioning 37

6.1 Decommissioning, storage and re-commissioning 37

6.2 Decommissioning and disposal 37

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1 Product specific information

1.1 Fundamental information

This hydraulic system has been manufactured in accordance with the directive 89/37/EC (EC-MCD) in its latest edition and the C-MCD and EN 982 this hydraulic system is a system that is not ready for use and is intended to be subsequently built into a machine.

These operating instructions are intended to provide information and to prevent hazards when installing the hydraulic system in the machine as well as information and guidelines for transport, storage and maintenance (inspection, servicing, repair) of the hydraulic system.

Only by strictly observing these operating instructions, is it possible to prevent accidents and material damage and ensure fault-free operation of the hydraulic system.

Furthermore observation of these operating instructions:

- Minimises stoppages and repair costs,
- Increases the service life of the hydraulic system.

This does not replace the operating instructions for the entire machine.

Warning

When the hydraulic system is fitted into a machine, the interaction between the entire machine and the hydraulic system, causes changes to the potential hazards. In particular, the influence of hydraulic and electrical controls on hydraulic drives which cause mechanical movements. This necessitates a hazard analysis and operating instructions for the entire machine.

Definitions: (EN 1070)

Hydraulic (fluid technology): Transmission, control and distribution of energy and signals by utilising a pressurised fluidic medium.

System: Components that are interconnected such that they can transmit and control fluidic energies.

Components: An individual unit (e.g. valve, filter, cylinder, motor), which comprises of one or more components, and is a functional part of a hydraulic system.

Drive: A component that converts the energy from the pressure medium into mechanical energy (e.g. motor, cylinder).

Piping system: Any combination of connections, couplings or pipe connections, hoses or pipes that permit the pressure medium to flow between the components.

Max. operating pressure: The highest pressure at which the system or part of the system may be operated under constant conditions.

1.2 Intended purpose, scope of supply

The hydraulic system is designed for the generation, control and regulation of oil flows for hydraulic drives in machines.

The product specific documentation (scope of supply, performance data and functions is detailed within the order (see order technical pre-amble or quotation check list), parts list, circuit, general assembly drawing as well as the test and acceptance certificates.

If hydraulic drives are shown within the hydraulic circuit, this is only to aid understanding of the hydraulic control. They are however not a component part of these operating instructions.

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User information:

- Parts list = Spare parts list,
- Circuit,
- Operating instructions.

1.3 Information regarding monitoring and safety functions

1.3.1 Monitoring functions

1.3.1.1 Monitoring the change of pressure fluid level

The pressure fluid level is not constant when the hydraulic system is in operation.

The level changes result from

- The differing volume requirements of plunger and differential cylinders or the loading/unloading of accumulators with pressure fluid during the work cycle.
- Leakage losses.

1.3.1.2 Monitoring via a level indicator

Due to the above stated reasons, it has to be determined by visually monitoring the fluid level, over a complete machine working cycle if and how much pressure fluid has to be added.

During operation, the pressure fluid level must **not** exceed the upper level mark and **not** fall under the lower level mark.

1.3.1.3 Monitoring via level indicator and temperature switch (if fitted)

Due to the above stated reasons, it has to be determined by visually monitoring the fluid level, over a complete machine working cycle if and how much pressure fluid has to be added.

During operation, the pressure fluid level must **not** exceed the upper level mark and **not** fall under the lower level mark.

If the filling level falls below or exceeds the defined points then an electrical signal is given which is actuated by a float. The switching points are identified with L1 to L.. (see circuit).

The switching points are defined to meet the technical requirements, e.g.:

- Switching point L3 = Maximum level
- Switching point L2 = Add pressure fluid
- Switching point L1 = System „Emergency off“
  The minimum level has been reached (danger that the pump will fail due to cavitation). This point lies below the minimum level on the oil level gauge.
- Temperature limit with a fixed switching point = System „Emergency off“
  The maximum permissible system temperature has been reached. The fault can be found and rectified with the aid of the fault cause analysis , chapter 5.2.5.8 H „Pressure fluid / operating temperature too high“.

1.3.2 Controlling and monitoring the pressure fluid temperature (if fitted)

Temperature switches are used to switch heat exchangers on or off (heaters, coolers) and for monitoring and indicating the operating temperature.

Thermostats are defined as per the technical requirements, e.g.:

- Thermostat 1 = Set value [°C] for switching the cooling „on“. The switch off point is determined by the switching hysteresis.
- Thermostat 2 = Set value [°C] for switching the heating „off“. The switch on point is determined by the switching hysteresis.
- Thermostat 3 = For monitoring functions; see circuit.

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1.3.3 Monitoring the filter

For the type see circuit/parts list

Table 1

Back pressure or differential pressure clogging indicator	Indicator	Notes
Without clogging indicator	No indicator	**5)**
Optical clogging indicator	Optical indicator with red pin or pressure gauge	Permanent indicator **1)**
Optical + electrical clogging indicator	Lamp or pin, electrical signal	Permanent indicator **1)** Signal suppression **2)**
Optical + electrical clogging indicator and electrical signal suppression until the oil temperature is +30 °C	Lamp or pin, electrical signal	Permanent indicator **1)** Signal suppression **3)**
Optical + electrical clogging indicator with a 2-point signal	Lamp or pin, electrical signal with 2 switching points, at 75 % + 100 % of the back pressure or differential pressure	Permanent indicator **1)** Signal suppression **4)**

1) If the permissible back/differential pressure at the filter element is exceeded then this results in an optical signal. With certain types of filter the red pin on the clogging indicator has to be pressed in daily (check function). The indicator has to be at its operating temperature. If during this check the pin jumps back out straight away, then at the latest, by the end of the shift the filter element must be changed.

2) During the cold start phase, due to the fact that higher oil viscosity = higher pressure, a filter „clogged“ signal usually occurs. The electrical signal should be suppressed until an average operating temperature > 30 °C has been reached.

3) During the cold start phase the electrical signal is suppressed until an operating temperature of 30 °C has been reached.

4) The electrical signal is transmitted at two switching points, i.e. 75 % and 100 % of the back/differential pressure. During the cold start phase, due to the fact that higher oil viscosity = higher pressure, a filter „clogged“ signal usually occurs. The electrical signal should be suppressed until an average operating temperature > 30 °C has been reached.

5) We recommend that a clogging indicator is fitted.

1.3.4 Protecting against unpermissible operating pressures

Safety valves must not be altered by the user of the system. The set value must be 10 % or at least 20 bar above the permissible system operating pressure (for details see circuit).

1.3.5 Information regarding safety measures

The performance capabilities of technical safety measures are split into 5 categories according to EN 954 (B, 1, 2, 3, 4). The categories describe the performance capabilities of the control in relation to their fault resistance and their reaction in the case of a fault due to the layout arrangement of the components and/or their reliability.

Unless otherwise agreed category B applies.

If higher safety requirements are demanded, then categories 1 to 4 are to be applied and agreed with the customer (also see the BIA Report 6/97).

1.3.5.1 Category „B“

Safety is achieved by the selection and reliability of the valves. The electrical control must conform to the requirements of EN 60204-1, so that unexpected start-up or not complying with a stop command due to a fault in the electrical control is prevented.

Category „B“ system performance:

- The occurrence of a fault can lead to the loss of safety functions.

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1.3.5.2 Category „1“

The requirements of category „B“ must be fulfilled. Well tried components and well tried safety principles must be applied.

Category „1“ system performance:

The occurrence of a fault can lead to the loss of safety functions, however the possibility of this occurring must be less than category „B“.

1.3.5.3 Category „2“

The requirements of category „B“ must be fulfilled and well tried safety principles must be applied.

The safety functions must be, in suitable time periods, checked by the machine control.

Category „2“ system performance:

- The occurrence of a fault can lead to the loss of safety functions between checks.
- The loss of a safety function is recognised by the check.

1.3.5.4 Category „3“

Safety is primarily achieved via the control structure. The considerations commence where the safety relevant signals are input and ends at the output of the power control elements.

The electrical control must conform to the requirements of EN 60204-1 point 5.3, so that an unintended start-up is prevented.

Category „3“ system performance:

- If a single fault occurs, the safety functions are maintained.
- Some, but not all, faults are recognised.
- A summation of unrecognised faults can lead to the loss of safety functions.

1.3.5.5 Category „4“

Safety is primarily achieved via the control structure. The considerations commence where the safety relevant signals are input and ends at the output of the power control elements.

The electrical control must conform to the requirements of EN 60204-1 point 5.3, so that an unintended start-up is prevented.

Category „4“ system performance:

- If a single fault occurs, the safety functions are maintained.
- A fault is recognised early enough to prevent the loss of safety functions.

1.4 Operating and environmental conditions

Unless other technical data is stated within the order then the following conditions apply.

1.4.1 Climate

Moderate climate zones; indoors the relative air humidity should be < 70 % at an ambient temperature of 22 °C.

1.4.2 Ambient temperature

0 ... +30 °C	For power units with surface cooled electric motors, without heat exchangers, with a free circulation of air.
< +40°C	With heat exchanger (nominal power to EN 60034-1 for continuous operation; 50 Hz, KT 40 °C and for use up to 1000 m above sea level)
-20 ... +50 °C	For control units

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1.4.3 Protection

A minimum of IP 55 with fitted and secured electrical connections.

Attention!
With vertical mounted electrical motors that do not have a protective cover, means are to be provided so that water and dust cannot enter directly.

1.4.4 Pressure fluid

Mineral oil based hydraulic oil to DIN 51524 part 2 (other mediums on request).

- Temperature
  Recommended for continuous operation +25 ... +55 °C
  permissible min./max. 0 ... +80 °C
- Viscosity
  Recommended for continuous operation 20 ... 100 mm²/s
  max. permissible 12 ... 500 mm²/s
  (see 4.3.2 pressure fluid, viscosity class selection)
- Contamination
  The permissible degree of contamination (undissolved foreign bodies in the pressure fluid) is dependent on the most contamination sensitive component within the system. The stated cleanliness class is the maximum permissible value which should not be exceeded taking consideration of:
  Operational safety (clogging of gaps, orifices, as well as sticking spools) and the service life (wear reduction) (see 4.3.1 Pressure fluid, demands and tasks, see filter concept AB 01-02.35).

  Required cleanliness classes to:

  ISO 4406 KL. 21/18/15 External gear pumps, piston and vane pumps, directional, pressure, flow and check valves, proportional and high response valves (corresponds approximately to class 9 of the standard NAS 1638, which is no longer valid)

  ISO 4406 KL. 19/16/13 Servo valves, servo cylinders (corresponds approximately to class 7 of the standard NAS 1638, which is no longer valid))

1.4.5 Hazard potential

1.4.5.1 Water contaminating products

When operating with water contaminating products, there is a hazard to lakes, rivers and canals, etc.

With regard to the „water protection act“ (WHG) and the regulation concerning the use of water contaminating products (VAwS), the following applies for Germany:

- Hydraulic systems lie within the group of HBV systems (systems for manufacture, treatment and use of fluids).
- In accordance with §19 h section 1 S.1 No. 2.b WHG, section. 2, the systems do not require a suitability check or type acceptance when the water contaminating material is to be found in the working process. This is the case with hydraulic systems.
- Unless otherwise stated the hydraulic systems are suitable for use with mineral oil to DIN 51524 part 2. These mineral oils are generally given the water hazard classification of 2.
- The water protection regulation (WHG) requires in §19 I for systems using water contaminating materials, that these are only erected, installed, maintained and cleaned by specialised companies. As Bosch Rexroth AG, Lohr am Main, is a member of the Fachbetriebsgemeinschaft Maschinenbau e.V. (FGMA) and is so defined as a specialised company to §19 i WHG.

For further information see AB-E 01-02.15 and AB-E 40-40.

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1.4.5.2 Explosive surroundings

Bosch Rexroth hydraulic systems can only be used in explosive atmospheres when they have been specifically designed for this application and that this has been explicitly documented within the „product specific documentation“.

Note:
The 94/9/EG directive (also named ATEX 100), controls the use of components and protective systems in explosive surroundings.

1.5 Unpermissible use

Warning

Operating the unit with:

- Higher operating pressures
- A non-specified pressure fluid and
- Deviating operating and environmental conditions

is not permissible.

1.6 Hydraulic system residual risks

Table 2

Hydraulic system residual risks	Hazard area	Protective measure(s)* / safety guidelines	Relevant standards
Escaping pressurised pressure fluid	Pressure lines (pipes and hoses)	Immediately stop leaks.	AB-E 20-06
	Hydraulic components (pumps, valves, filters, measurement equip., cylinders, etc.)	De-pressurise hydraulic systems before commencing any maintenance work.	
	Accumulators	Attention! Unload the accumulator, lower loads.	
Ignition of the escaping pressure fluid in the vicinity of ignition sources	Ignition source with a surface temp. > than the flame point of the fluid being used (for HLP 46 approx. 220 °C)	Screen (shield)	
Wipping of a pressure line after ripping off	Hoses	Hoses have a limited service life. They are - To be checked by a qualified person - To be replaced in the required time scales, even if no safety technical problems are visible (see 5.1.5 hoses) Dependent on the place of application, the hose may require a retainer or screen (shield).	AB-E 01-02.06 AB-E 23-10 AB-E 33-16
Dangerous movement of drives and pressure generation due to unauthorised manual operation	Valve hand overrides Hand operated valves Control relays	Commissioning using the hand overrides of control elements is not recommended. If so, then it must only be carried out by qualified personnel (see 2.3 personnel qualifications). The operator is responsible for safe movement sequences and the build-up of pressure.	
Water or ground contamination due to leaks in the hydraulic system	Hydraulic reservoirs Components and pipe work that lie outside the oil reservoir	Suitable retaining measures; leak-free system to accept water contaminating fluid that is escaping from reservoirs/pipes.	AB-E 01-02.15 AB-E 40-40
Danger of burning due to surface temperatures > 80 °C	Surfaces of individual components and pressure lines	Let the hydraulic system cool down before commencing any maintenance work. Wear protective clothing.	

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Table 2 continued

Hydraulic system residual risks	Hazard area	Protective measure(s)* / safety guidelines	Relevant standards
Noise Continuous noise pressure levels > 85 dB(A) at the place of work	Classification level ≥ 90 dB (A)	De-couple the hydraulic system. Anti-noise hood. (Sound insulation cover) Provide appropriate ear protection	AB-E 43-01 AB-E 01-02.05
Falling Slipping Tripping	Hydraulic system in general steps, platforms	Do not use the hydraulic system and pipe work as steps. Remove any traces of hydraulic oil from walkways. The general safety regulations must be complied with.	
Knocking Squashing	Parts falling during assembly/disassembly of the hydraulic system or individual components.	Particular care has to be taken with components installed in the reservoir, as the weight and centre of gravity can not always be directly recognised (see 5.2.7; vertically mounted motor pump assemblies). The general safety regulations must be taken into account.	
Basic hazards	All components during maintenance	Only components stated within the parts list may be exchanged by new, identical, tested components of original equipment quality. Components may only be dismantled for repair purposes, as described within the component specific operating instructions.	
Electrical shock	Electrical equipment	Via appropriate maintenance it is to be ensured that it is not possible to come into contact with live components due to isolation breaks caused by early aging or damage due to improper use .	

Warning

The required * **protective measures** or those for the **user relevant rises** results from the rise analysis of the entire machine.

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1.7 Herstellererklärung nach RDEF 00025/10.01

Industrial Hydraulics | Electric Drives and Controls | Linear Motion and Assembly Technologies | Pneumatics | Service Automation | Mobile Hydraulics

Rexroth Bosch Group

RDEF 00 025/10.01
Ersetzt / *Replaces / Remplace*: 11.00

EG-Herstellererklärung / *EC-Declaration by the manufacturer / Déclaration CEE du fabricant*

im Sinne der EG-Maschinen-Richtlinie 98/37/EG, Anhang II Abschnitt B
as defined by EC-machinery directive 98/37/EC, Annexe II Section B
au sens de la directive machines de la CEE 98/37 CEE, Annexe II Section B

Der Hersteller erklärt, dass die gelieferten Bauteile/Baugruppen in Übereinstimmung mit den angewendeten harmonisierten Normen/Spezifikationen hergestellt worden sind.
Die Inbetriebnahme dieser Bauteile/Baugruppen ist solange untersagt, bis festgestellt wurde, dass die Maschine, in die diese Bauteile/Baugruppen eingebaut werden sollen, den Bestimmungen der EG-Richtlinie entspricht.

The manufacturer declares that the components/sub-assemblies delivered have been manufactured in accordance with the stated harmonized standards/ specifications.
The components/sub-assemblies must not be operated until the machine into which these components/sub-assemblies are to be incorporated has been declared in conformity with the provisions of the directive.

Le fabricant déclare que les composants/sous-ensembles livrés ont été fabriqués conformément aux normes/spécifications harmonisées utilisées.
La mise en service de ces composants/ sous-ensembles est Interdite jusqu'à ce qu'll ait été constaté que la machine dans laquelle ces composants/sous-ensembles doivent être intégrés est conforme aux stipulations de la directive européenne.

Angewendete harmonisierte Norm:

EN 292 -1 (11.1991)
Sicherheit von Maschinen

EN 292 -2 (06.1995)
Grundbegriffe, allgemeine Gestaltungsleitsätze

EN 982 (09.1996)
Sicherheitstechnische Anforderungen an fluidtechnische Anlagen und Bauteile; Hydraulik

EN 983 (09.1996)
Sicherheitstechnische Anforderungen an fluid-technische Anlagen und Bauteile; Pneumatik

EN 60 204-1 (06.1993)
Sicherheit von Maschinen;
Elektrische Ausrüstung von Maschinen

Applied harmonised standards:

EN 292 -1 *(11.1991)*
Safety of machines

EN 292 -2 *(06.1995)*
Basic concepts, general principles for design

EN 982 *(09.1996)*
Safety requirements on fluid power installations and components Hydraulics

EN 983 *(09.1996)*
Safety requirements on fluid power installations and components Pneumatics

EN 60 204-1 *(06.1993)*
Safety of machinery;
electrical equipment of machines

Norme harmonisée utilisée:

EN 292 -1 *(11.1991)*
Sécurité des machines, terminologie de base, méthodologie

EN 292 -2 *(06.1995)*
Sécurité des machines, principes techniques et spécifications

EN 982 *(09.1996)*
Prescriptions de sécurité d'installations et composants fluidiques Hydraulique

EN 983 *(09.1996)*
Prescriptions de sécurité d'installations et composants fluidiques Pneumatique

EN 60 204-1 *(06.1993)*
Sécurité des machines;
équipement électrique des machines

Hersteller / *Manufacturer / Fabricant*:
Bosch Rexroth AG
Industrial Hydraulics

Postfach
D - 97813 Lohr am Main

Bauteil / Baugruppe:
Component / Sub-assembly:
Composant / Sous-groupes: . . . . . .

Seriennummer / Auftrags-Nr:
Serial number / Order Nbr:
Numéro de série / Commande No: . . . . . .

Baujahr:
Date of construction:
Date de fabrication: . . . . . .

Stellung im Betrieb:
Position:
Position: . . . . . .

. . . . . .
(Datum, Unterschrift) *(Date, Signature) (Date, Signature)*

1/1 RDEF 00 025/10.01

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2 General information

2.1 Area of validity

These operating instructions are only valid for hydraulic systems manufactured by Bosch Rexroth AG, industrial hydraulics business unit.

2.2 Liability

Any material defect or liability claim against Bosch Rexroth AG. will be invalid, in the case of damages caused by use other than for the agreed purpose or unauthorised actions that are not provided for in these operating instructions.

For details of material defect liability please refer to the contract documents.

2.3 Personnel qualification

Hydraulic technical knowledge means that personnel must,

- Be capable of reading and fully understand hydraulic circuits,
- In particular fully understand the interrelationship of the built-in safety systems and
- Have knowledge regarding the function and build-up of hydraulic components.

A **qualified person** is one who, due to his technical training and experience, has sufficient knowledge that he

- Can evaluate the work transferred to him,
- Can recognise possible hazards,
- Can instigate measures to eliminate hazards,
- And has the required repair and assembly knowledge.

2.3.1 **Personnel for maintenance and inspection** (chapter 5.1)

The following requirements have to be fulfilled:

- Experienced personnel,
- Hydraulic technical knowledge is required.

Care

Filter and oil changes belong to the maintenance activities.

2.3.2 **Personnel for commissioning** (chapter 4)**, maintenance** (chapter 5.2) **and de-commissioning** (chapter 6)

The following requirements have to be fulfilled:

- Experienced personnel,
- Hydraulic technical knowledge is required,
- EN 50110-1 (VDE 0105-1) “operation of electrical installations” applies for any work that is to be carried out on the electrical system.

Danger

Incorrectly carried out work can cause injury as well as present a safety hazard in the operation of the system including a danger to life.

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2.4 Basic safety guidelines

Warning

a) Are the
   - Hazard and safety guidelines on the machine,
   - Operating instructions, describing how to react during operation so that accidents and health problems are prevented. These are to be created by the operator/company that have, e.g. to take into account the accident prevention regulations,
   - Operating instructions describing how to correctly and safely use the hydraulic system for the intended purpose.

b) Mineral oil based hydraulic oils are hazardous to water and are inflammable. It can only be used if the relevant safety data sheet from the manufacturer is present and that all of the measures stipulated therein have be implemented.

c) The hydraulic system can only be used when it is in a technically perfect condition.

d) The intended use, performance data and application conditions must not be changed.

e) Protective measures/components may not be rendered inoperable, e.g. limit switches, valves and other control elements must not be bypassed.

f) If, for maintenance purposes, protective measures have to be bypassed then safety measures must be carried out beforehand to ensure that a hazardous situation can not occur. The main machine operating instructions are to be taken into account.

g) The actuation of component adjustment systems or changes to programmable control systems must only be carried out by authorised personnel (see 2.3 Personnel qualifications)

h) In the event of an emergency, fault or other irregularities:
   - Switch off the hydraulic system and secure the master switch so that it cannot be switched back on
   - Immediately notify the responsible personnel.

i) Uncontrolled access of non-company personnel to the immediate operational area of the hydraulic system is prohibited (this also applies if the hydraulic system is not operational).

2.5 Responsibilities and obligations of the machine manufacturer/operator

The operating instructions do not include the in-company operating instructions that are to be created by the operator/owner and are to regulate the personal behaviour in the company to prevent accident, health and environmental risks.

The supplied equipment is exclusively intended to be built into a machine or assembled with other machines as part of a complete machine.

Warning

The commissioning of the supplied equipment is therefore not permitted until it has been established that the machine into which the equipment is to be assembled complies with all requirements of the relevant EC-directives (see 1.7 Manufacturer's declaration)

The operating instructions are a basis for the operating instructions of the complete machine which are to be produced by machine manufacturer.

These operating instructions must be read, understood and all points observed by the responsible and operating personnel.

They must be kept in a known and accessible place immediately by the hydraulic system and be permanently to hand.

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In Germany hydraulic systems that are operated with mineral oil (DIN 51524; in general WGK 2), are within the sense of the water protection act WHG §19 g „Systems for handling water hazardous substances “.

Hydraulic systems lie within the HBV group of systems (systems to manufacture, handle and use fluids).

According to §19 h par. 1 S.1 No. 2.b WHG, systems do not require a suitability check or a design acceptance when the water hazardous materials are used in a work process. This is the case with hydraulic systems.

The binding obligations of the operator of a water hazarding system (WHG § 19 i) are länder (German states) specific and are regulated in the relevant VawS.

2.6 Conventions

Table 3

Danger	This symbol indicates a threat of danger which will directly result in death or very serious injury if not avoided.
Warning	This symbol indicates a threat of danger which may result is death or very serious injury if not avoided.
Caution	The symbol indicates a possible danger which may lead to minor or serious injury or material damage.
	This symbol indicates back-up information.

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3 Transport and storage

3.1 Transport

Hydraulic systems can be, dependent on the size and local conditions, transported by means of a fork- lift truck or lifting equipment.

Attention

During transport the appropriate safety regulations are to be complied with.

Only transport hydraulic systems **without** being filled with oil.

Bosch Rexroth hydraulic systems are delivered unfilled. It is possible that **oil residue** from testing may be present (in the product), (deviations see 3.2.1 „Increased internal corrosion protection by filling“).

3.1.1 Transport with a forklift truck

Built-on equipment (components, pipe work, etc.) must not come into contact with the forklift truck.

- Place the forks under the reservoir and
- Carefully lift and take care to ensure that the centre of gravity in correct/stable.

3.1.2 Transport with lifting equipment

Built-on equipment (components, pipe work, etc.) must not come into contact with the lifting equipment.

- Suitable lifting equipment is to be attached to the reservoir’s lifting lugs,
- Carefully lift and take care to ensure that the centre of gravity in correct/stable

(see Loading regulations, transport devices, means of attachment AB-E 02-70.01).

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3.2 Storage

Excerpt from AB-E 01-02.11: Hydraulic components and hydraulic units, guidelines for interior conservation.

3.2.1 Factory corrosion protection

Bosch Rexroth hydraulic systems are tested as standard with mineral oil HLP 68 DIN 51524 part 2.

After testing the remaining oil film provides the internal conservation.

For longer storage times, as an option, MZ 45 corrosion protection oil can be used.

Increased internal corrosion protection is achieved by filling (the internal chambers remain full of protective oil).

3.2.2 Carrying out the internal corrosion protection

Referring to the values stated in table 4 preservation is achieved by testing or filling of the units or components.

Testing means a short running period using the protective medium. The medium is then drained from the reservoir or component. All pipe connections are then plugged.

If table 4 states that the conservation is achieved by filling, the protective medium is used to test the unit or component. The protective medium remains in the component or unit.

The pipe connections are plugged using fittings or blank flanges. Reservoirs do not have to remain filled, it is sufficient to fill the built-on components, e.g. pumps, filters, valves, etc.

Notes on reservoir internal paint finish.

Reservoirs intended for use with a HLP pressure fluid are protected against corrosion by means of an inner coating (zinc dust coating to AB-E 01-03.05 RAL 7000).

Table 4

Storage condition	Packing suitable for	Protective medium	Storage time in months (3 / 6 / 9 / 12 / 24)
Storage in dry, constant temperature rooms	Sea freight	A	
	Non sea freight	A	
		B	
Storage in the open (protected against damage and water ingress)	Sea freight	A	
		B	
	Non sea freight	A	
		B	

Test with protective medium
Fill with protective medium
A = Mineral oil
B = Corrosion prevention oil

If the storage period is longer than as stated in table 4 the components, especially the hydraulic pumps, have to be dismantled and cleaned in a suitable cleaning fluid to remove any protective medium residues, the seals also have to be changed.

3.2.3 Notes on external protection

The exterior is protected using coating methods (corrosion protection) as stated in AB-E 01-03.05.

For storage up to six months in dry, constant temperature rooms. It is sufficient to used the under coat Epoxy to AB-E 01-03.05.

If the storage period exceeds six months the relevant top coat should be applied (see AB-E 01-03.05).

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3.2.4 Guidelines for packing hydraulic components and units

If packing is opened for inspection purposes then it is to be carefully resealed. With packing suitable for sea freight, the desicannt material also has to be renewed.

For further information regarding internal conservation see AB-E 01-02.11

4 Commissioning

4.1 General notes

Attention!
EC-MCD (EC-Machinery Directive) annex II B states, that commissioning cannot take place until it has been determined that the machine into which this machine (hydraulic system) is to be built into, conforms to all of the relevant EC regulations (see 1.7 „Manufacturers declaration“ and 2.5 „Responsibilities and obligations of the machine manufacturer/operator“)

Combining components can result in further/other hazards occurring. It is therefore a requirement that the guidelines stated within the complete machines' operating instructions are taken into account.

This, of particular importance for „ mechanical hazards“ EN 292-1 section 4.2, that could occur due to machine movements initiated by the hydraulic system and drives (cylinder, motor).

4.1.1 Safety

See 2.4 „Basic safety guidelines“

4.1.2 Personnel qualifications

Commissioning may only be carried out by trained and instructed personnel with specialised hydraulic knowledge (see 2.3 „Personnel qualifications“).

4.1.3 Cleanliness

During all kinds of work, great emphasis is to be placed on cleanliness, as contamination can lead to faults and can influence the correct function of the components. Before loosening fittings and components, the immediate outside area has to be cleaned, all openings are to be closed by means of protective caps so that contamination cannot enter the system. Rags are not to be used for cleaning purposes.

4.1.4 Painting

If hydraulic systems are to be repainted, then care is to be taken to ensure that elastic materials (seals, hoses, anti-vibration mount, etc.), labels, indicators, scales of measuring and control equipment, running surfaces of cylinders and valve mounting surfaces, as well as connections are covered/protected.

4.2 Commissioning of functionally tested hydraulic units

4.2.1 Building in or on

4.2.1.1 Visual check for transport damage and contamination

Long storage times can lead to the seals becoming brittle and that the anti-corrosion oil becomes resinous (see 3.2.2 Carrying out internal conservation).

4.2.1.2 Installation and fixing of units and sub-assemblies

Care has to be taken to ensure that there is sufficient space available for access, operation and maintenance, as well as the orientation and mounting of components and systems so that stability and operational reliability is ensured.

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4.2.1.3 Connecting the hydraulic drive

The interconnecting pipes are to be dimensioned in accordance with the performance data stated within the circuit.

Warning

The required nominal pressures for fittings and hose fittings partially lie above the values stated in DIN EN ISO 8434-1. Only components from manufacturers that guarantee these higher pressures are to be used.

The pipes are to be cleaned of dirt, slag and chips before installation. Welded pipes in particular must be internally clean and flushed. Rags must not be used for cleaning purposes.

The installation instructions of the fitting manufacturer are to be observed. Fittings with a soft seal at the interface between the body of the fitting and the component into which it is to be fitted are recommended (pipe thread to ISO 1179-2, metric threads to ISO 9974-2). Sealing materials such as hemp and putty are not permissible as they cause contamination and can therefore cause functional faults. Bosch Rexroth recommends the Walform pipe forming system to AB-E 20-06.

Hoses must comply with all of the associated European and/or international standards (see 5.1.5 Hoses).

Connection ratings are to be checked before electrical installation of the drive and controls.

Connect cooling water if required.

4.2.2 Filling the system

When filling the system, cleanliness is most important! Clean the filling screw and the plug on transport and storage containers before opening them. Check the oil reservoir for contamination and clean if necessary.

Fill the oil reservoir with the specified or a suitable pressure fluid. The correct pressure fluid, in particular the viscosity, is a deciding factor for trouble-free operation of the system (see 1.4 Operating and environmental conditions as well as 4.3 Pressure fluid).

Check the pressure fluid to ensure that there has been no ingress of water.

Do not remove filter sieves at the filling point or elements from filters during the filling process.

The base level of contamination of the pressure fluid, which is to be filled into the reservoir, must not exceed the maximum permissible cleanliness class (see „Flushing the system“).

Experience has shown that new pressure fluids often lie above these values. In such cases the pressure fluid is to be filled via a special filtration unit.

Recommendation:
To ensure that the cleanliness class is maintained, filling should be carried out via filtration unit.
Monitor the maximum/minimum fluid levels, take into account the volumes contained within the interconnecting pipe work and actuators.

4.2.3 Before commissioning

- **Valve settings;** Set the operating pressure valves (**Attention!** Not the safety valves) and flow control valves to their lowest settable values and directional valves in the neutral position (see 1.3.4 Safety against non permissible pressures).

  The command values for proportional valves should also be reduced.

- **Accumulators;** If accumulators are fitted in the hydraulic system then the local regulations are to be observed before commissioning and during operation.

  „Product specific operating instructions“ are provided for each accumulator.

  The documentation provided with the accumulator(s) is to be carefully filed so that they are available for subsequent inspections by a specialist.

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Accumulators are to be pre-charged to the values stated on the circuit diagram. Filling and testing takes place via a test/filling assembly (for this see „Product specific operating instructions“).

Attention: Only use nitrogen as the filling gas! (nitrogen class 4.0 reinst; Nz 99,99 Vol-%)

The operator is responsible in ensuring that the checks before commissioning and the subsequent repeat inspections/tests are carried out.

- **Piping systems;** Are to be checked to ensure that they are in a safe operation condition by a responsible person.
- **Filling the pump housing;** for pumps with a drain connection, the housing has to be filled with pressure fluid (also see „Product specific operating instructions“).

4.2.4 Commissioning

- **Open isolator valves in the suction line,** if fitted.
- **Slowly start the drive motors;** Electric motors in inching mode, combustion engines in the idle mode. Ensure direction of rotation is correct.
- **Bleed** the system in the actuator lines at the highest possible point. Actuate directional valves and extend and retract the actuators several times. Slowly increase the load. Complete bleeding has been carried out when there is no foam in the reservoir, actuators do not make jerky movements and no abnormal noises can be heard.

  Attention: Run the system at a low pressure until the hydraulic system has been fully bled.
- Monitor the **fluid level** in the reservoir, if necessary top up.
- **Flushing the system**

  When installing the hydraulic system into the machine (addition of components, pipe work systems and drives) it must be ensured that the maximum permissible degree of contamination, cleanliness class to ISO 4406 KL. 21/18/15 for the entire system is not exceeded.

  Systems which contain servo valves = cleanliness class to ISO 4406 KL. 19/16/13 must be flushed. The servo valves are to be replaced by flushing plates or directional valves of the same nominal size. The system is to be operated at its operating temperatures and minimum pressure until the required cleanliness class to ISO 4406 is reached (see 1.4.4). The cleanliness class is measured by using a particle counter.

  The filter elements are to be changed as required.
- **Final valve settings and running in of the machine** in accordance with the details stated in the circuit diagram or the machines operating instructions.

  The switching processes (acceleration, delays, pressure increases, etc.) of valves with switching time adjustment/ramps are to be optimised, taking the dynamic relationships into account.
- **Adjusting and optimising proportional valves** (see General operating instructions).

  The product specific operating instructions are to be observed.
- **Monitoring of the final operating temperature;** after the machine has been operating for a longer period of time.
- **Rectifying leakage points;** Check joints, after the machine has been in operation for a period of time, for leaks.
- **Problems during commissioning;** Identical hydraulic systems can have differing function or fault characteristics after being fitted into the machine, due to machine specific conditions (weights, speeds, electrical controls, command values, etc.).

  As an aid for systematic fault finding or localising faults, the matrix for „fault causes and their effects in hydraulic systems“ is available (see 5.2.5).

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4.3 Pressure fluid

4.3.1 Requirements and tasks

4.3.1.1 Pressure fluid requirements

- Mineral oil based hydraulic oils
- That the minimum requirements of DIN 51524 part 2 are fulfilled
- Other fluids on requests

4.3.1.2 Safety guidelines

Mineral oil based hydraulic oils

- Are materials that are hazardous to water,
- Are flammable (take the ignition point into account),
- May only be used it the relevant safety data sheet is present for the pressure fluid that is intended to be used, and that all of the measures stated therein have been implemented .

4.3.1.3 The tasks of the pressure fluid

- To transmit hydraulic energy from the pump to the hydraulic cylinder/motor,
- Lubrication of moving parts,
- Corrosion protection,
- Removal of impurities,
- The removal of locally accumulated heat.

4.3.1.4 Hydraulic oil characteristics

The characteristics of hydraulic oils diminishes (chemical changes) as it ages.

The following factors accelerate the ageing process:

- High temperatures (as a rule of thumb at oil temperature; above 70 °C the speed at which the oil ages doubles for each 10 °C increase),
- Air (oxygen),
- Water,
- Metallic catalysts and contamination.

Acids and resinous residues form, which can lead to valve spools sticking.

4.3.1.5 Selection and maintenance of pressure fluids

Due to the many tasks of the pressure fluid, its selection and maintenance is of vital importance for the

- Operating safety,
- Service life,
- Economy

of a hydraulic system.

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4.3.2 Selecting the viscosity class

The most important technical characteristics of a pressure fluid is the value of its thickness = viscosity.

The viscosity values stated within the data sheets are the governing factors.

Pumps and hydraulic motors, in particular, demand that the permissible viscosity ranges are complied with. If the viscosity is too high (thick fluid) then this leads to cavitation, a low viscosity results in increased leakage losses = warming and thereby a further reduction in the viscosity. Subsequently the lubrication limits will be reached.

The viscosity of a pressure fluid, measured in SI-units [mm²/s], changes with temperature.

The viscosity classifications to ISO-VG are based on a reference temperature of 40 °C, e.g. ISO-VG 46 relates to 46 mm²/s at 40 °C.

The viscosity classes are included in the type code (e.g. HLP 46).

The hydraulic units operating conditions (dependent on the pump type, switching/proportional/servo valves), demand that the following viscosity ranges are maintained:

- Recommended range for continuous operation 20...100 mm²/s
- Briefly permissible for cold start-up (for pumps speeds up to 1800 U/min) 500 mm²/s
- Minimum permissible 12 mm²/s

The selection of a suitable viscosity class for a

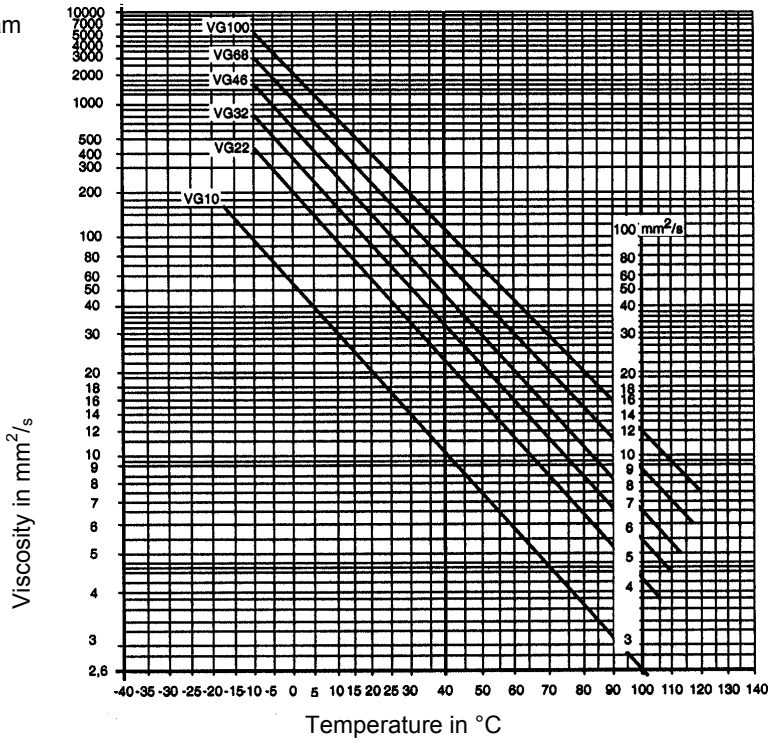
- Pressure fluid temperature range of 0...+ 80 °C

Can be determined herewith.

Example for ISO-VG 46 (recommended for Central European climate or enclosed rooms) results from the relationship between the oil temperature and the viscosity:

Viscosity temperature diagram

Viscosity temperature diagram



The **priority** when **selecting** a viscosity grade is the permissible viscosity range. At given ambient and pressure fluid temperature it is not always possible to fulfill all requirements by varying the viscosity clas.

In this case **HV-oils** with viscosity index improvers can be used or an oil cooler/heater may be employed.

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4.3.3 Oil type selection

4.3.3.1 HLP (DIN 51524 part 2)

Mineral oil based hydraulic fluids with additives for increased corrosion protection, ageing resistance and increased wear protection.

4.3.3.2 HV (multi grade hydraulic oil)

Hydraulic oils with a particularly low viscosity temperature relationship.
The other characteristics are as HLP oils.

5 Maintenance

As defined by DIN 31051, encompasses all measures required to maintain and restore as well as to determine and assess the actual condition of technical systems.

These measures are divided into three categories:

- Maintenance: Measures to maintain the required condition
- Inspection: Measures to determine and assess the actual condition
- Corrective maintenance: Measures to restore the required condition.

In this way the functionality of the hydraulic system can be ensured in the most economic manner .

Bosch Rexroth systems are so designed, that they have high functionality (operational safety, service life). They only require minimum maintenance. This is however necessary to guarantee the functionality of the system.

From experience 70 % of all faults and damage to hydraulic systems is indirectly caused by the pressure fluid. Therefore the primary inspection and maintenance work is in checking and carrying out measures to maintain the functionality of the fluid (condition, cleanliness class) (see 1.4 „Operating and environmental conditions*")*.

5.1 Maintenance and inspection

5.1.1 General notes

5.1.1.1 Personnel qualifications

Maintenance and service work may only be carried out by trained and instructed personnel (see 2.3 „Personnel qualifications*")*

5.1.1.2 Safety

See 2.4 „Basic safety guidelines"

5.1.1.3 Scope and time intervals for maintenance and inspection

The basis for the recommendations are: Central European climate, average loading and operating conditions and the environmental conditions that are normally to be found in metal processing companies (see 5.1.8 „Maintenance and inspection intervals").

5.1.1.4 Inspection documentation

It is recommended that inspection results are documented,

a) so that by taking into account functionality and economics, it is possible to match the inspection and maintenance intervals to the actual operating conditions,

b) so that comparisons can be made enabling the possibility of early fault recognition.

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A steady increase in temperature and/or shorter filter element change intervals point to possible wear of pumps, control lands, seals and ageing of the pressure fluid and should be a trigger to check all of the affected components.

A sudden fast increase in temperature is a warning sign and requires that the system be checked immediately.

A further aspect is the simplified processing of possible guarantee claims.

5.1.2 Pressure fluid

5.1.2.1 Pressure fluid temperature

A maximum oil reservoir temperature of 55 °C is recommended for mineral oil, as an increase in the operating temperature results in an accelerated ageing of the oil and a reduction in the service life of seals and hoses.

5.1.2.2 Pressure fluid condition

The ageing and contamination of the pressure fluid is dependent on a multitude of operating conditions, such as temperature, operating pressure, filtration, increases of contamination from the environment via the breather systems and movement seals between moving parts, air humidity, etc..

A visual check can only give a rough estimation (the pressure fluid becoming opaque, looking darker than at the time of filling, sediment in the reservoir).

A laboratory check is recommended. Corrective action is dependant on the results:

- Ageing and/or sedimentation. Fluid is to be changed.
- Contamination (the cleanliness class is not being maintained). Filtration via a separate filtration unit.

To remove sedimentation and large volumes of water, it is recommended that approx. 90 % of the reservoir volume is removed via an external filtration unit and cleaned. The rest is to be removed complete with the contamination and water and to be subsequently disposed of.

5.1.2.3 Changing the pressure fluid

For oil that is not subject to laboratory monitoring an oil change is necessary after successful first commissioning and each time approx. 4000 operating hours have been reached. A prerequisite is however, that the maximum oil reservoir temperature of 55 °C has not been exceeded and that regular filter monitoring and filter element changes have taken place.

Via the appropriate oil maintenance and monitoring of the pressure fluid, the oil change intervals can be greatly increased.

If the fluid volume falls below the marked minimum level, faults can occur (see Fault effects 5.2.5: A10, H12) **the pressure fluid level** is therefore to be checked and if necessary oil is to be added.

Take care to **ensure** that when **filling,** the same type and make of oil is used.

5.1.3 Filter monitoring

5.1.3.1 Filters with a clogging indicator

Filters with clogging indicators permanently measure the degree of contamination. The contamination retention capacity of the filter is fully utilised (see 1.3.3 „Filtration monitoring“).

Attention is to be paid when filter elements rarely or never have to be replaced; Clogging indicators does not show filter element change required. If the clogging indicator is functional then the filter element is defective or the bypass, valve if fitted, does not close correctly, e.g. due to entrapped particle.

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5.1.3.2 Changing the filter element (see Maintenance 5.2.4)

Attention!
The safety guidelines and the qualification requirements for maintenance 5.2.1 are to be observed.

Air breathers permit filtered air to be exchanged in the oil reservoir when the oil level fluctuates.

The correct function is to be checked dependant upon environmental conditions and if necessary replaced.

5.1.4 Accumulators

Accumulators are pressure vessels and the local (place of use) safety regulations apply (see Product specific operating instructions).

In addition to the prescribed checks the gas pressure also has to be monitored.

Measuring/checking the gas pre-charge pressure takes place by the means of a test/charging kit (see Product specific operating instructions).

Before dismantling the accumulator the oil side must be de-pressurised.

Attention: Only use nitrogen as the pre-charge gas (nitrogen to class 4.0 reinst; N_2 99.99 Vol-%)!

Warning

Particular care must be taken when working on systems which contain accumulators as carelessness and incorrect procedures can lead to serious accidents.
No welding, brazing or any mechanical work in any form or manner is permitted on the accumulator vessel.

See „Product specific operating instructions for accumulators“.

5.1.5 Hoses

5.1.5.1 Hazards

The incorrect use or selection of hoses can lead to fatal accidents, personal injury and material damage.

5.1.5.2 Storage and service life

Even when hoses have been correctly stored and applied, hoses are subject to natural ageing. Therefore their **service life is limited** (see 1.6 Residual risks).

Hoses must, according to EN 982, meet all of the requirements that are specified in all of the applicable European and/or International standards.

In hydraulic systems high dynamic loads (fast internal pressure changes, pressure peaks, etc.) can occur. The requirements that are stated in the hose standards can, in specific applications, be too low. In this case hoses with strengthened fittings to AB-E 23-16 are used.

Warning

Strengthened hoses can only be replaced by hoses of the same specification.

5.1.5.3 Testing

Unless there are other regulations then hoses should be checked for operational safety before the first commissioning and then at least once a year by an **authorised person**.

Manufacturer’s instructions with regard to **storage life** must be complied with. The storage room should be cool (up to 25 °C), dry and protected against sunlight. O-zone generating sources are to be prevented as they reduce the hose service life.

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5.1.5.4 Storage time and service life

The service life of hoses should not exceed six years including a maximum storage time of two years (excerpt from DIN 20066).

The service life is defined as the duration of use and any storage time from the date of manufacture.

When the hose is manufactured, the hose itself (stock length) should not be older than four years.

Details for procurement of **spare parts** regarding dimensions, requirements, testing and identification are contained in DIN 20066 „Hoses“.

5.1.5.5 Inspection criteria (excerpt from DIN 20066)

Functionality, in respect to the recommendations stated within 5.1.8 „Maintenance and inspection intervals“, is to be checked.

5.1.5.6 Replacing hoses

Hoses are to be replaced when, during the inspection, the following criteria are determined:

1. Damage to the external layer; down to the wire/textile braiding (e.g. rubbing points, cuts or tears).
2. Enbrittlement of the outside layer (rips in the hose material).
3. Deformation of the hoses natural form, in the de-pressurised and pressurised condition (also see DIN 20066).
4. Leakage points.
5. Damage or deformation of the hose fitting (taking the sealing function into consideration; small surface damage is no reason to change the hose.
6. Evidence that the hose is coming out of the fitting.
7. Function and strength reducing corrosion of the fitting.
8. The installation requirements of the hose have not been observed (see DIN 20066).
9. The storage and in-service life has been exceeded.

If the user has no details regarding the storage and in-service life, then the standard values are recommended.

5.1.6 Coolers

Oil/air coolers are, dependent on the ambient conditions, to be regularly cleaned.

Oil/water coolers; The cleaning intervals are dependent on the water quality, the temperature and the water flow. Cleaning is also dependent on the cooler type.

5.1.7 Set values

Pressure valves, flow valves and pump controls as well as signal elements, e.g. pressure switches, limit switches, temperature controllers, etc. are all set during the first commissioning. Checks should be carried out to ensure that these values have not changed.

Adjustments of valves for setting operating pressure are critical (e.g. variable displacement pump pressure controllers). With incorrect settings, i.e. if the difference between the operating pressure and safety valve pressure is too small (see 1.3.4), then the safety valve opens during normal operation which increases losses and causes a large increase in the pressure fluid temperature.

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5.1.8 Maintenance and inspection intervals

Table 5

	Commissioning* (1st week)	Continuous operation*	Key words	Section
Pressure fluid:				
Oil level	D	D		1.3.1
Temperature	D	D		1.4 1.3.2
Condition (oil sample; visual)	W	1000 h	Contamination; Water in oil Aged oil	5.1.2
Analysis / change	–	4000 h	Without an analysis replace after 4000 h hours If the analyse is ok., then remove oil sedimentation to 4.1.2	5.1.2
Filter				
Monitoring clogging indicators	D	D		1.3.3
Check the air breather		500 h	Dependent on the ambient conditions	5.1.3.2
Accumulators				
Check the gas pressure and mounting	1^{st} to 2^{nd} week after 500 h	500 h		5.1.4
Repeat checks		B	The regulations for the place of operation apply.	5.1.4
Measurement, visual, touch, acoustic check				
Operating pressure at the pressure gauge	D	W		
External leakage	D	W	Formation of drops of oil	
Contamination	D	W	Air inlets of electric motors, oil coolers	
Damage and secure fixing of all components	W	500 h	Including wiring and electrical connections	
Hoses	W	1000 h		5.1.5
Noises, vibration	D	W	Running and flow noises, switching shocks	5.2.5 „A“
The function of measurement equipment	W	1000 h		

Operating hours/time scales:

D	= Daily,		
W	= Weekly	or after	40 operating hours
500 h	= Quarterly	or after	500 operating hours
1000 h	= Half yearly	or after	1000 operating hours
2000 h	= Yearly	or after	2000 operating hours
B	= As required		

* If irregularities are found during the checks, then the check intervals are to be shortened. If the inspection results are documented and no negative points are found during the checks then the time periods can be extended. This in particular applies to the oil analysis.

During the start-up phase, and long term operation, with appropriate care and attention and the documenting of maintenance and inspection results in a maintenance handbook, it is possible to carry out preventative maintenance.

Attention!
Negative trends in the test parameters, e.g. pressure fluid temperature, frequency of filter element replacement or noises indicate changes. By using the fault matrix it is possible to localise the problem.

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5.2 Repairs

5.2.1 General guidelines

5.2.1.1 Personnel qualifications

Repair work must only be carried out by trained and instructed personnel who have specialised hydraulic knowledge (see 2.3 Personnel qualifications).

5.2.1.2 Safety

Due to safety reasons no pipe joints, connections and components are to be loosened as long as the system is pressurised. Lower all loads, unload accumulators, switch off pumps and secure them from being switched back on. The general safety regulations are to be observed (see points 1.6 Residual risks and 2.4 Basic safety guidelines).

5.2.1.3 Cleanliness

During all work particular care is to be taken with regard to cleanliness. Before loosening any fitting or components, the immediate area has to be cleaned. All openings are to be plugged with protective caps so that contamination cannot enter the system. Do not use rags for cleaning.

5.2.2 Maintenance tasks

5.2.2.1 Fault finding

Determining damage or preventive maintenance. Determining and localising the (potential) fault source(s).

To successfully carry out fault finding within a hydraulic system, knowledge regarding the design and operation of the individual components is a pre-requisite. Hydraulics combined with electrics/electronics naturally complicate fault finding and necessitate the co-operation of hydraulic and electrical personnel. Circuit, parts list and possibly the functional diagram and other information should be available.

As an aid for systematic fault finding or localising faults, a matrix for „fault causes and their effects“ in hydraulic systems is available (see 5.2.5).

5.2.2.2 Fault rectification

Faults can primarily be corrected by replacing the defective component on-site.

Only parts stated within the parts list (spare parts) can be replaced with new interchangable and tested components and these must be of the same quality as the original equipment (see hazard area „All components through maintenance“ in 1.6 Residual risks).

Component repair is generally carried out by the manufacturer or his authorised workshop. If a repair is provided for and described in the component specific operating instructions then it may be carried out by the operator provided appropriate expertise and facilities are available.

After rectification of the actual damage, the cause and possible consequential damage must also be rectified. For example, if a pump fails due to wear then the system should be flushed and the oil cleaned or replaced.

5.2.2.3 Functional testing and acceptance

Dependent on the scope of the work which is to be carried out, the procedure as for commissioning is to be carried out (see 4).

If required, documentation is to be corrected/supplemented or notes added to the maintenance handbook, so that in future the fault may be eliminated/minimised through appropriate maintenance.

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5.2.3 Removing/fitting components

The guidelines stated within the component specific operating instructions that are provided with the replacement component are to be observed.

General guidelines:
to prevent control spools jamming, hydraulic components have to be fitted free of tension. Mounting surfaces must therefore be flat. The fixing screws are to be evenly tightened to the prescribed tightening torque.

When working on systems that contain **accumulators,** particular care and attention is required **as improper actions lead to serious accidents**. No welding, brazing or any mechanic work in any form or manner is permitted on the accumulator vessel.

The guideline stated within the accumulator operating instructions must be complied with.

5.2.4 Changing the filter element

Attention!
The safety guidelines and qualification requirements for maintenance works stated 5.2.1 are to be observed.

5.2.4.1 Changing the element

If the clogging indicator signals that the element is clogged, then it should, at the latest by the end of the shift, be exchanged. Care should be taken when replacing the element.

5.2.4.2 Exchanging or cleaning the filter elements

- Fibre elements **must** be replaced and **must not** be cleaned.
- **Used** filter elements contain oil. Let them drain throughly and **dispose** of them in a **correct manner**.

5.2.5 Fault causes and their effect on hydraulic systems

An overview of the effects of a fault:
A) Excessive noises,
B) Insufficient force/torque (pressure) at the drives,
C) Uneven drive movements (pressure and/or flow oscillations),
D) The drive does not move or is too slow (none or too little flow),
E) The drive does not stop or overruns,
F) The pump switches on and off loads too frequently,
G) Switching shocks when valves are switched,
H) The operating/pressure fluid temperature is too high,
I) Contaminated pressure fluid.

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5.2.5.1 Fault effect „A“: Excessive noises

Table 6

Fault source		Fault cause
1	Mechanical drive component	1. Coupling: Incorrectly aligned, loose, defective 2. Pump or motor fixing loose 3. Defective pump or motor 4. Wrong direction of rotation
2	Suction conditions	Unfavourable suction conditions due to: 1. Air breather clogged or too small 2. The suction line isolator valve is not fully open 3. Suction line is blocked, too small , too many bends 4. Located 1000 m above seal level 5. Suction line is not air-tight, air is being sucked in 6. See A10
3	Pump	1. Incorrect direction of rotation or the speed is too high 2. The suction and pressure lines exchanged 3. Defective pump seals/pump 4. Oscillating control system 5. See A1, A2
4	Pressure lines	1. Pipe mounts missing or loose 2. Incorrectly fitted (e.g. not free of tension) 3. Flow noises due to the cross-section being too small 4. See A10
5	Return lines	1. See A4 2. Switching shocks, due long return lines and/or too high flow velocities. The oil column is not pre-loaded
6	Pressure valves	1. Flow noises and oscillation due to incorrect valve selection, unfavourable characteristic curve or the flow is too high 2. Valve oscillations causes other controller to oscillate
7	Flow valves	1. See A6 2. Flow control valve pressure compensator oscillation
8	Isolator valves	1. See A6 2. Vibration caused by control pressure fluctuations with pilot operated check valves 3. Performance limits have been exceeded (flow too high)
9	Directional valves	1. See A6 2. Valve rattles, defective solenoid or the voltage is too low
10	Pressure fluid	1. Fluid level is too low 2. The viscosity is too high (temperature is too low, oil with an unsuitable viscosity grade) 3. The pressure fluid foams (too much air in the fluid) 1 to 3 results in, dependent on the combinations, suction problems = pump noise, flow noises, switching shocks
11	Drive (cylinder/motor)	Wear on the running surfaces

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5.2.5.2 Fault effect „B“: Insufficient power/torque (pressure) at the drives

Table 7

Fault source		Fault cause
3	Pump	1. Defective pump (see A3) 2. Pump flow too low or with variable pumps the de-swash pressure is set too low, see B 12-2 3. The controller is defective
4	Pressure lines	The pipe resistance is too high (length, cross-section, pipe bends)
5	Return lines	See B4
6	Pressure valves	1. The operating pressure is set too low, see B 12-2 2. The valve seat is contaminated, damaged or worn 3. The safety valves are set too close to the operating pressure relief valve (d > 20 bar), so that flow can pass to tank
7	Flow valves	Incorrect settings, see B 12-2
8	Isolator valves	See B 12-2
9	Directional valves	Incorrect switched position (e.g. zero pressure circulation, the valve does not switch or the spool jams), see B 12-2
10	Pressure fluid	1. The viscosity is too low > leakage is too high 2. The viscosity is too high > flow resistance is too high
11	Drive (cylinder/motor)	1. Internal leakage (e.g. worn cylinder seals) 2. Friction is too high (in the cylinder, e.g. due to side loading at the piston rod or seal elements)
12	Others	1. Check the display instruments 2. The sum of the flow/ working resistance and/or leakage is too high

5.2.5.3 Fault effect „C“: Uneven drive movements

Table 8

Fault source		Fault cause
3	Pump	Fluctuating flows, with variable displacement pumps, caused by: 1. Defective pump, controller 2. Unsuitable pilot control valve 3. Influences from the system acting io the controller 4. See B 3-2
6	Pressure valves	See B 6
7	Flow valves	1. Changes to the flow rates at the throttle valves due to pressure changes 2. Fluctuations at the pressure compensator when the natural frequency of the drive is low
8	Isolator valves	See A 8-2
9	Directional valves	See A 9
10	Pressure fluid	Entrapped air in the pressure fluid (see „I“)
11	Drive (cylinder/motor)	1. Hydraulic motor speed below minimum limit 2. Stick-Slip-Effect (jerky movement) with cylinder (the lower the stick friction the lower the cylinder speed can be)
12	Others	1. Insufficient load holding on the return side of the drive 2. The system has not been fully bled

5.2.5.4 Fault effect „D“: The drive does not move or is too slow (none or insufficient flow)

Table 9

Fault source		Fault cause
3	Pump	See B 3 and B 12-2
6	Pressure valves	See B 6
7	Flow valves	See B 7
9	Directional valves	See B 9
11	Drive (cylinder/motor)	See B 11
12	Others	The start conditions have not been met. Electrical control lines (plugs) disconnected, signal elements (e.g. pressure switches are incorrectly set or defective) or limit switches are not being reached

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5.2.5.5 Fault effect „E“: The drive does not stop or follows on

Table 10

Fault source		Fault cause
8	Isolator valves	1. Do not close or are too slow due to back pressures 2. The valve seat is contaminated or defective
9	Directional valves	1. Switching time adjustment is too slow 2. The drive creeps due to the internal leakage of the valve (design constrictions).
11	Drives (cylinder/motor)	Internal leakage, e.g. due to worn out cylinder seals
12	Others	1. The system has not been adequately bled 2. The electrical signal processing from the contact switch to the adjustment element is defective or too slow 3. The valve spool jams (e.g. due to contamination)

5.2.5.6 Fault effect „F“: Pump on or off load switching too frequent

Table 11

Fault source		Fault cause
11	Drive (cylinder/motor)	Force = The operating pressure should be maintained, without accumulators, when the pump is switched off. The compression volumes (e.g. the volume within the drive and pipes/hoses) is in relation to the system leakage too low.
12	Others	For systems with accumulators: 1. The oil demands from the actuator and/or leakage is too high 2. The oil volume is not or only partially available: - Isolator valve to the accumulator is closed - Bladder (membrane) defective - Gas pre-charge, operating and set pressures (e.g. pressure switches do not meet the requirements)

5.2.5.7 Fault effect „G“: Switching shocks when valves are switched

Table 12

Fault source		Fault cause
4	Pressure lines	See G 9, A 4
5	Return lines	See G 9, A 5
6	Pressure valves	Opens too fast, e.g. with electrical unloading, increase the switching time by means of orifices
8	Isolator valves	Opens too fast. Increase the switching time by means of orifices
9	Directional valves	Optimise the switching time influence between the delay E 9-1 and the severity of the switching shocks
10	Pressure fluid	See fault source „I“; entrapped air in the oil
11	Drive (cylinder/motor)	1. Compression energy (the product of the compression volume x the pressure) is dissipated too quickly 2. The kinetic energy (weight x velocity) is too high (see G 9-1)
12	Others	1. The system is not fully bled 2. With accumulator systems, when the accumulator energy is switched to a low pressure potential (see G 9-1)

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5.2.5.8 Fault effect „H“: Pressure fluid temperature too high

Table 13

Fault source		Fault cause
3	Pump	With fixed displacement pumps the generated energy (pressure x flow) is greater than the machine's energy requirements (e.g. during set-up).
12	Others	1. Increased efficiency loses due to changed conditions. They primarily result from faults caused by fault reaction B „insufficient force“. 2. Due to inadequate heat dissipation : - Not enough fluid in the reservoir - The ambient temperature is too high - Insufficient heat dissipation due to encapsulation - With an oil/water cooler the cooling water is not available or is insufficient (inlet pressure is too low or there is sedimentation in the cooler) - With oil/air coolers the air flow is disrupted (e.g. by the cooling covers being blocked) - The cooler control and adjustment elements should be checked to ensure that they are set to the correct values and that they are functional 3. Pressure relief valves that are set too low or isolator valves that are not correctly closed on accumulator or safety blocks

5.2.5.9 Fault effect „I“: Contaminated pressure fluid

Table 14

Type	Effect
Solid particle contamination	1. Coarse particles result in the sudden failure of components. 2. Fine particles cause wear (internal leakage, control inaccuracy), jamming of valves and the formation of an oil sediment.
Water in oil	Corrosion, increased wear.
Entrapped air (air bubbles) in the oil	1. Increase the oil compressibility which can result in jerky drive movements and switching shocks. 2. Increase the danger of cavitation wear on metallic surfaces, locally high fluid temperatures as well as the destruction of seals when unloading.

The combined effects of all contamination types is increased ageing of the oil which results in a chain reaction (see 4.3.1 Requirements and tasks of the pressure fluid).

5.2.6 Assembly guidelines for couplings to AB-E 33-22/KD

5.2.6.1 General

The following has to be taken into account when dismantling or assembling:

- The couplings must not be removed/fitted using a hammer.
- The fitting or withdrawing is mainly carried out by hand or with a suitable withdrawal tool. The coupling halves can be warmed up to simplify fitting.
- **Attention** the maximum temperature to which they can be warmed is 100 °C. “Danger of burning”.

Distance between the coupling halves:

- The service life of the coupling spider and thereby the coupling is dependent on the correct axial coupling half separation. Dimension **„s“** for each coupling size (stated on the spider) can be obtained from the table.
- Coupling halves for cylindrical shafts (electric motor and pump) must have at least 90 % of the coupling halve length fitted onto the cylindrical shaft.

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5.2.6.2 Assembling the coupling

Both coupling halves are to be so assembled that **A = B + s**

- **A** ; Measured from the pump mounting bracket connection flange to the base of the pump coupling half, i.e. base of the claws
- **B =** (A - s); Measured from the electric motor connection flange to the end of the motor coupling half, i.e. the top of the claws,

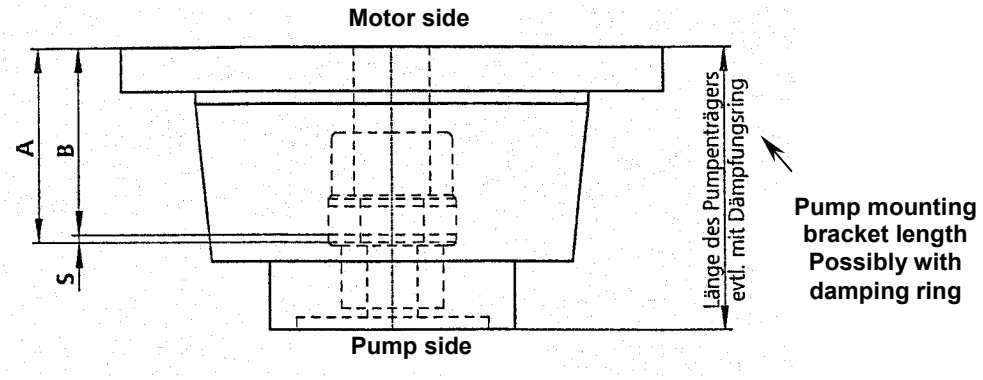
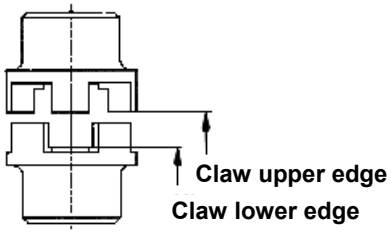


Table 15

Coupling type KD	19	24	28	38	42	48	55	65	75	90	100	100
Dim. „s“	2	2	2,5	3	3	3,5	4	4,5	5	5,5	6	6,5

To clarify the measurement points, the drawing has been drawn as an exploded view:



5.2.6.3 Securing the coupling half onto the shaft

a) Cylindrical shaft with key:
The coupling is secured via the fixing screw provided (grub screw with cutting ring).

b) Splined shaft:
The coupling half is in the form of a clamp and is therefore clamped onto the shaft with a radial force (see AB-E 33-22).

c) Conical shaft:
The coupling half is fixed by means of a disc and axial screw. The correct tightening torque can be obtained from the pumps operating instructions.

e.g. M 6 6 + 2 Nm,
M12 50 + 10 Nm,
M14 70 + 15 Nm,
M16 100 + 10 Nm.

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5.2.7 Assembly guidelines for vertically mounted motor pump assemblies

5.2.7.1 General safety guidelines

This maintenance activity requires specialised knowledge (EN 292-2) and should therefore only be carried out by trained personnel.

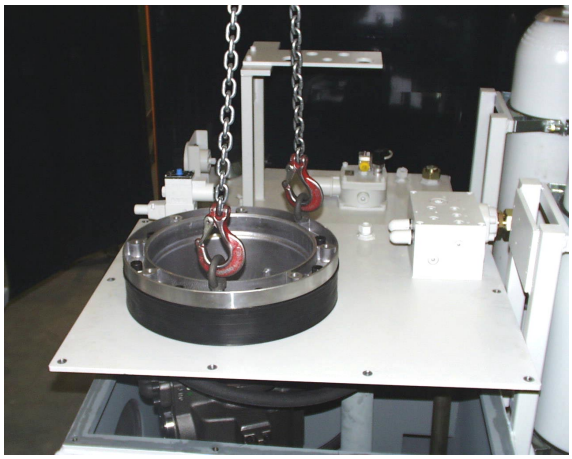
Hazard

Hazards when removing the motor pump assembly:

- The weight is not known
- The centre of gravity is not necessarily in the middle of the assembly
- Always use suitable lifting equipment

5.2.7.2 Disassembly procedures

Dismantling the motor pump assembly is carried out in two steps:



1. Remove the electric motor.
2. As can be seen from the above photograph, two lifting eyes are to be screwed into the threaded holes in the pump mounting bracket. The unit should then be slightly lifted to check to see whether the centre of gravity is satisfactory, so that the unit can be dismantled without any hazard.

The procedure is reversed for re-assembly.

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6 Decommissioning

Attention!
When decommissioning and (partially) disassembling the hydraulic system, the following has to be taken into account:

1. Assembly/disassembly work should only be carried out by trained and experienced personnel who have knowledge of hydraulics (see 2.3 „Personnel qualifications“).
2. Due to safety reasons, no pipe work, connections or components may be loosened/removed when the system is pressurised. Before any work commences loads are to be lowered, accumulators unloaded, pumps are to be switched off and secured against being restarted. The general safety regulations are to be taken into account (see 1.6 „Residual risks“ and 2.4 „Basic safety guidelines“).

6.1 Decommissioning, storage and re-commissioning

Dependent on the storage conditions and storage time, the appropriate anti-corrosion measures are to be carried out (see 3.2 „Storage“).

When re-commissioning, the commissioning guidelines are to be taken into account (see 4 „Commissioning“).

6.2 Decommissioning and disposal

The individual materials are to be disposed taking the environmental requirements into account. Particular care has to be taken with components that contain pressure fluid residues. The pressure fluid safety data sheet guidelines are to be observed when carrying out any disposal activities.

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